



University of Memphis College of Education

College of Education
The University of Memphis
Counseling, Educational Psychology, & Research
EDPR 8005

Structural Equation Modeling Applied to Education
Spring 2009

Dr. Yonghong Jade Xu

College of Education Norms

I take 100% responsibility.
I seek equity of voice.
I am willing to talk about sensitive issues.
I listen for understanding.
I appreciate the strengths and contributions of others.
I bring positive energy and encouragement to the team.
I commit to the mission of the college.

EDPR 8005 Special Topics:

Structural Equation Modeling Applied to Education

Instructor: Yonghong Jade Xu, Ph. D.
Office: Ball Hall 300D
Email: yxu@memphis.edu (preferred method of contact)
Office Phone: (901) 678-5026
Course URL: <https://umdrive.memphis.edu/yxu/public/>

Course Description:

This course centers on the application of SEM in educational research. A good understanding of the major concepts and processes of multiple regression and measured-variable path analysis is expected. This course integrates learning SEM with writing of a publishable research paper in an academic area. Prerequisite: EDPR 8544 or 8549.

Overview

This course extends the discussion of multiple regression and path analysis (EDPR 7/8544) to *Structural equation modeling* (SEM). SEM grows out of multiple regression and is used to evaluate proposed causal relationships between two or more variables with a linear equation system. SEM is a more powerful multivariate technique than multiple regression because it takes into account the modeling of interactions, correlated independents, measurement error, correlated error terms, and latent variables.

SEM takes a confirmatory approach to analyzing a structural model that specifies a theory-driven causal process. By incorporating and integrating factor analysis and path analysis, a typical SEM analysis usually takes two steps: validating the measurement model and fitting the structural model. The former is accomplished primarily through confirmatory factor analysis, while the latter is accomplished primarily through path analysis with latent variables.

The measurement model. The measurement model is the part of the SEM model that evaluates how well the latent variables are represented by their indicators. Latent variables, or factors, are theoretical and/or underlying constructs that cannot be observed directly. A researcher must operationally define the latent variables of interest and identify their observable and measurable indicators (i.e., measured variables). In SEM analysis, a pure measurement model is a confirmatory factor analysis (CFA) model serving to confirm that how the indicators sort themselves into factors is consistent with how the researcher has linked the measured variables to the latent variables. If the fit of the measurement model is found to be acceptable, then the researcher can proceed to the second step of testing the structural model.

The structural model. The structural model defines relations among the latent variables. If the analysis shows the structural model having good fit indices, it indicates the proposed causal model fits the data well enough to serve as a plausible explanation of reality and a parsimonious representation of the variable relationships. If needed and justifiable, modifications can be made to the structural model to increase model fit.

Software. *LISREL*, *AMOS*, and *EQS* are the three popular SEM statistical packages. In this class, LISREL will be used because it is the package of reference in most articles about structural equation modeling in education and social sciences. A free downloadable student version of LISREL can be accessed at <<http://www.ssicentral.com/lisrel/mainlis.htm>>.

Key Objectives:

Students will learn to

1. Understand the principles of SEM and how this multivariate technique is related to multiple regression, path analysis, and factor analysis;
2. Practice step-by-step SEM construction in educational research. Usually, there are five steps:
 - Model Specification
 - Model Identification
 - Model Estimation
 - Testing Model Fit
 - Model Manipulation
3. Learn to use LISREL, a SEM software package, to conduct SEM analysis.
4. Be able to read and comprehend articles that use SEM for data analysis.
5. Be able to report SEM findings in scholarly writings.

Instructional Approach:

The general format for this course is for the instructor to introduce SEM through lecture and by providing research examples. The student then is expected to complete weekly reading, writing, or data analysis assignments, and participate actively in class discussion.

Required Text:

Kline, R. B. (2004). *Principles and practice of structural equation modeling* (2nd ed.). New York, NY: the Guilford Press.

Recommend Text:

Raykov, T., & Marcoulides, G. A. (2000). *A first course in structural equation modeling*. Mahwah, NJ: Lawrence Erlbaum Associates.

Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8: Structural equation modeling with the SIMPLIS Command Language*. Lincolnwood, IL: Scientific Software International, Inc.

Byrne, B. M. (1998). *Structural equation modeling with Lisrel, Preliis, and Simplis: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Additional Reading:

Aldea, M. A. & Rice, K. G. (2006). The role of emotional dysregulation in perfectionism and psychological distress. *Journal of Counseling Psychology*, 53(4), 498-510.

Briddle, B. J. & Marlin, M. M. (1987). Causality, confirmation, credulity, and structural equation model. *Child Development*, 58, 4-17.

Hoyle, R. H. & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 158-176). Thousand Oaks, CA: Sage.

McDonald, R. P. & Ho, M. R. (2002). Principle and practice in reporting structural equation analyses. *Psychological Methods*, 7, 64-82.

Muller, R. O. (1997). Structural equation modeling: Back to basics. *Structural Equation Modeling: A Multidisciplinary Journal*, 4, 353-369.

Raykov, T., & Widaman, K. F. (1995). Issues in applied structural modeling research. *Structural Equation Modeling: A Multidisciplinary Journal*, 2, 289-318.

Raykov, T., Tomer, A., & Nesselroade, J. R. (1991). Reporting structural equation modeling results in psychology and aging: Some proposed guidelines. *Psychology and Aging*, 6(4), 499-503.

Rosser, V. J. (2004). Faculty members' intentions to leave: A national study on their worklife and satisfaction. *Research in Higher Education*, 45(3), 285-309.

Additional Items Needed for the Course:

You will need to have a University of Memphis email account, which allows you access to the University's computer system (where SPSS is located). You will need to have a calculator with basic statistical functions (e.g., Texas Instruments TI 30 Xa or Casio FX-260), as some calculations will be done by hand (bring your calculator to class). You will also need some sort of data storage device (i.e., USB drive, or CDRW) to save your files.

Tentative Schedule:

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|----------|---|
| Jan 21 | Introduction and overview |
| Jan 28 | SEM notation, path tracing, and math preparation |
| Feb 4 | Path analysis and introduction to LISREL/SIMPLIS |
| Feb 11 | Path analysis in detail and more on LISREL/SIMPLIS |
| Feb 18 | Confirmatory factor analysis and measurement model |
| Feb 25 | Latent-variable SEM: A two-step process |
| Mar 4 | Class presentations: SEM paper critique Assignment 1 due |
| Mar 11 | Spring break |
| Mar 18 | More on CFA & reliability and validity |
| Mar 25 | Multi-group SEM |
| Apr 1 | Data analytical assignment |
| Apr 8 | Testing mean structures Assignment 2 due |
| Apr 15 | Literature review and data preparation for the final paper |
| Apr 22 | Non-recursive models |
| April 29 | Final paper due |

Course Grades:

Grades will be determined by your performance on the assignments, the exams, and the final project. The grading scale is absolute, not relative (not based on a curve), so that one student's grade does not influence another student's grade.

| Assignments & Project | Proposed Date | % of Course Grade |
|-----------------------|--------------------|---------------------|
| Two (2) assignments | See class schedule | 40 (20 points each) |
| Final project | April 29, 2009 | 55 |
| Class participation | | 10 |

90 – 100 % = A 80 – 89 % = B 70 – 79 % = C 60 -69 % = D Below 60 = F

Course Assignments:

Two (2) take-home assignments will altogether make up 40% of your overall course grade. Each assignment will be a representative amount of practice questions corresponding to the class materials. You are required to turn in the completed assignment on time for full credit. Late work will NOT be accepted. I would strongly encourage you to work independently on the assignments and discuss your answers in a group of two or three since you can learn a great deal from one another.

The first assignment (Assignment 1) is 20% of the course grade. For this assignment, you are required to critique a published article that used SEM for data analysis. You will present your critique in writing and also as a class presentation. The second assignment (Assignment 2) is another 20% of the course grade and will be a data analysis task. You can analyze your own data if you prefer, or I will provide data for you. You need to turn in you SIMPLIS syntax, output, and interpret and summarize your findings in writing.

Final Project

The final project will be worth 60% of the course grade. You will need to produce a publishable paper, in which you conduct SEM of a data set (it could be the same data set and analysis you did for Assignment 2). This project should not be treated as a technical report of a simple run of some LISREL program. You must begin with a review and discussion of the theoretical rationale of your causal model in the context of literature in the field. The structural equation modeling must be an appropriate choice for your data analysis. You need to discuss your findings, draw conclusions, as well as identify limitations of your study. You need to follow the APA style when writing and formatting the paper.

Notes and Reminders:

The class will start and end on time. Please make every effort **not to** come in late and I will make every effort **not to** keep you late. If you must arrive late or leave early, please let me know in advance by email.

This course covers a lot of material in a relatively short period of time. In order to keep up and do well, you need to 1) attend all of the class meetings, 2) read the assigned chapters at least twice (once before the lecture and once again after), and 3) participate in class discussions and activities.

Additional readings/handouts may be distributed or made available on my UMDrive throughout the course of the semester.

Any areas that are not covered in this syllabus (as well as any adjustments/changes or corrections) will be addressed as they present themselves during the semester).

ALL PAGERS AND CELL PHONES MUST BE TURNED OFF DURING THE CLASS!

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Academic Integrity and Student Conduct:

Expectations for academic integrity and student conduct are described in detail on the website of the Office of Student Judicial and Ethical Affairs (<http://saweb.memphis.edu/judicialaffairs>). Please take a look, in particular, at the sections about “Academic Dishonesty,” “Student Code of Conduct and Responsibilities,” and “Disruptive Behaviors.” I will expect students to be aware of these guidelines and to conduct themselves accordingly.

Americans with Disabilities Act:

The University of Memphis does not discriminate on the basis of disability in the recruitment and admission of students, the recruitment and employment of faculty and staff, and the operation of any of its programs and activities, as specified by federal laws and regulations. *The student has the responsibility of informing the course instructor (at the beginning of the course) of any disabling condition, which will require modification to avoid discrimination.* Faculty are required by law to provide "reasonable accommodation" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.

Written Assignments and Academic Misconduct:

All written work submitted must be the student's original work and conform to the guidelines of the *American Psychological Association (APA)* available online and via their publications. This means that any substantive ideas, phrases, sentences, and/or any published ideas must be properly referenced to avoid even the appearance of plagiarism. Plagiarism includes, but is not limited to, the use, by paraphrase or direct quotation, of the published or unpublished work of another person without full or clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency in the selling of term papers or other academic materials. It is the student's responsibility to know all relevant university policies concerning plagiarism. Any documented cases of plagiarism can and will result in dismissal from the course with a failing grade, and may result in other more serious sanctions by the College of Education.

Your written work may be submitted to Turnitin.com, or a similar electronic detection method, for an evaluation of the originality of your ideas and proper use and attribution of sources. As part of this process, you may be required to submit electronic as well as hard copies of your written work, or be given other instructions to follow. By taking this course, you agree that all assignments may undergo this review process and that the assignment may be included as a source document in Turnitin.com's restricted access database solely for the purpose of detecting plagiarism in such documents. Any assignment not submitted according to the procedures given by the instructor may be penalized or may not be accepted at all. Please refer to the University's "Code of Student Conduct" for actions that may result from student academic misconduct.